Albendazole therapy and reduced decline in haemoglobin concentration during pregnancy (Sierra Leone)

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Abstract

WHO recommends that anthelmintic treatment be included in strategies to improve maternal nutrition in areas where hookworms are endemic and anaemia is prevalent. At present, few countries have adopted this recommendation, partly owing to the lack of data to support the adverse effects of hookworms on maternal health. A longitudinal study was conducted on 125 women in Sierra Leone (in 1995/96) to measure the impact of single-dose albendazole (400 mg) and daily iron--folic acid supplements (36 mg iron and 5 mg folic acid) on haemoglobin and serum ferritin concentration during pregnancy. Women who received both albendazole and iron--folic acid supplements experienced no significant change (P > 0.05) in the prevalence of anaemia and iron-deficiency anaemia between the first and third trimesters. These prevalence levels significantly increased (P < 0.05) in women who received either albendazole or iron--folic acid supplements or neither. After controlling for baseline haemoglobin concentration and season, the mean decline in haemoglobin concentration between the first and third trimester in women who received albendazole was 6.6 g/L less than in women who received the control (P = 0.0034). The corresponding value for iron--folic acid supplements was 13.7 g/L haemoglobin (P < 0.001). The effects of albendazole and iron--folic acid supplements were additive. These findings lend support to WHO's recommendation for anthelmintic treatment during pregnancy.

Keywords: anthelmintics, albendazole, pregnancy, anaemia, iron deficiency, iron--folic acid supplements, Necator americanus, Ascaris lumbricoides, Trichuris trichiura, Sierra Leone

Introduction

Soil-transmitted nematode infections prevail in tropical and sub-tropical regions, where iron-deficiency anaemia is a major public-health problem. Hookworms (Necator americanus and Ankylostoma duodenale) are the leading cause of pathological blood and iron loss in these regions (FLEMING, 1989). Trichuris trichiura also causes intestinal blood loss, although much less than hookworms on a per-worm basis. Ascaris lumbricoides infection appears to reduce the utilization of vitamin A, a vitamin that is reported to improve iron metabolism and haemoglobin (Hb) levels (MIJIA & CHEW, 1988; BLOEM et al., 1990). Hookworms, T. trichiura and A. lumbricoides may all worsen iron status further by causing reduced intake of dietary iron due to poor appetite and vomiting and by increasing excretion of dietary iron owing to diarrhoea. Hookworm infection is known to be an important contributor to iron-deficiency anaemia in women of child-bearing age (WHO, 1996a). Worldwide, an estimated 44 million pregnant women are infected with hookworms (BUNDY et al., 1995). As iron-deficiency anaemia is a major threat to safe motherhood, WHO recommends that anthelmintic treatment after the first trimester of pregnancy be included in strategies to improve the nutritional status of pregnant women in areas where hookworm infection is endemic (prevalence > 20--30%) and anaemia is prevalent (WHO, 1996a).

Anthelmintic treatment is already included in national strategies for the prevention and control of maternal anaemia in Sri Lanka and the Seychelles. Many other countries where hookworm infections are endemic have yet to follow their example. A major obstacle has been the fear that the anthelmintic treatment may have teratogenic effects on the foetus. According to WHO, the risks of delayed anthelmintic treatment with albendazole, mebendazole, levamisole, or pyrantel outweigh the teratogenic risks to the foetus (WHO, 1996a). A second major obstacle is the lack of information to support the adverse effects of hookworms on maternal health and the public health benefits of anthelmintics. A study in Sri Lanka reported that a single course of mebendazole treatment after the first trimester of pregnancy, in addition to daily iron--folic acid supplements, improved Hb concentration and iron status in pregnant women (ATUKORALA et al., 1994). This study is frequently quoted in support of anthelmintic treatment during pregnancy. However, neither the prevalence nor the severity of hookworm infection was assessed. Therefore, it is difficult to extrapolate the results of this study to other communities where the prevalence and intensity of hookworm infection are known. It has been suggested that the findings from this study may encourage the use of anthelmintics during pregnancy in areas where hookworms do not pose a threat to maternal iron status and Hb levels (PAWLA et al., 1988). In developing countries, where financial and human resources for maternal health are extremely limited, there is need to document the health benefits of anthelmintic treatment during pregnancy more adequately with unequivocal evidence from intervention studies, if convincing arguments are to be constructed for the integration of anthelmintics into antenatal care programmes.

The efficacy of albendazole and iron--folic acid supplements for the control of maternal iron-deficiency anaemia was investigated in western Sierra Leone with a view to determining priorities for intervention. The objective of the study was to measure the impact of single-dose albendazole and daily iron--folic acid supplements on the change in Hb concentration and serum ferritin concentration between baseline (first trimester) and the third trimester in a cohort of pregnant women.

Materials and Methods

Study area and population

Women in their first trimester of pregnancy, attending 3 antenatal clinics in peri-urban Freetown and 6 rural areas in Port Loko District between December 1995 and June 1996, were invited to participate in the study. The selection criteria included Hb concentration  80 g/L and gestational age < 14 weeks at baseline.

Study design

At enrolment, a questionnaire was administered to obtain information on the demographic, social and reproductive background of each subject, including age, place of residence, marital status, ethnic group, maternal education, occupation, sanitary facilities, source of drinking water, number of children, gravidity, parity and number of months since previous pregnancy. A baseline assessment was performed in the first trimester of pregnancy (10--14 weeks gestation). Intervention began at the first antenatal visit in the second trimester. Follow-up assessments were conducted in the second
in response to studies that indicate that the efficiency of ferrous gluconate (Kerfoot Pharmaceuticals, Aston-un-
was applied in order that the 2 interventions, daily iron-
with the controls (C, and C,). The intervention groups
ing dose-dependent gastrointestinal side-effects. A daily
anv subiect's bodv stores
dose of 5 mg folate is considered sufficient to replenish
iron supplementation is desirable as it is economically
advantageous and may improve adherence by minimiz-
the daily supplementary dose

A randomized controlled 2 X 2 factorial design
was applied in order that the 2 interventions, daily iron-
folate supplements (Fe) and single-dose albendazole (A)
be simultaneously compared with each other and with
the controls (C,A and C). The intervention groups
thus comprised FeA, FeCa, C,A and C,Ca. Intervention
groups were allocated using random-number tables to
ensure random number sequence. The unit of randomization
was the individual.

Albendazole (proprietary name Zentel, Smithkline-
Becham Pharmaceutical Laboratories Nanterre, France), 2 x 200 mg, was selected as previous studies
have shown it to be more effective against N. americanus
than other recommended anthelmintics (WHO, 1996b).
The iron-folate supplements comprised 36 mg iron as
ferrous gluconate (Kerfoot Pharmaceuticals, Aston-under-Lyne, UK), and 5 mg folinic acid (Cox Pharmaceuticals,
Widdon Valley, UK). A low iron dose was chosen in
response to studies that indicate that the efficiency of
iron absorption and utilization is increased by lowering
the daily supplementary dose (VITERRI, 1997). Low-dose
iron-folate supplementation is desirable as it is economical,
advantageous and may improve adherence by minimiz-
doing dose-dependent gastrointestinal side-effects. A daily
dose of 5 mg folate is considered sufficient to replenish
any subject's body stores (FLEMING, 1989). Two tablets
containing calcium with vitamin D (Regent Laboratories
Ltd, London, UK) were used as the control for albenda-
zo. These tablets were similar to the iron-folate supple-
ments in shape and size but were different in
colour. The use of calcium and vitamin D as a control for
albendazole was considered acceptable as both calcium and vitamin D are not known to have any
anthelmintic activity. Calciferol tablets (1-25 mg calci-
ferol equivalent; Regent Laboratories Ltd, London,
UK), 1 daily, were chosen as the control for the iron-
folate supplements. These tablets were similar to the iron
supplements in shape and size but were different in
colour. Calciferol has not, to our knowledge, been linked to
anthelmintic activity. iron metabolism or erythropoi-
esis.

Parasitology

Stool samples were fixed in 10% formalin within
30 min of collection and examined using the modified
were prepared for each sample and the mean of the 3 mea-
urements was used in subsequent analyses. A second
observer re-examined 10% of slides for quality control.
In 88% of re-examinations, the egg counts were within
19% of the first examination. To confirm the species of
dracoaria in the study areas, 50 unfixed stool samples
were cultured using a modified version of the Harada
and Mori faecal culture method (Pawlowski et al., 1991).

Haemoglobin and serum ferritin

Hb concentration of the capillary-blood sample was
measured using a portable B-Haemoglobin Photometer
(HemoCue®, Angelholm, Sweden). The venous-blood
sample was obtained by venepuncture, transferred to a
gel-separator serum-collection tube and spun at 1500 g
for 10 min. The serum was stored at −20°C until analysis
for SF concentration by immunoradiometry (111T) using
the ICN Ferritin Mab Immunoradiometric Assay kit
(ICN, High Wycombe, UK). Each assay was controlled
internally by a commercial tri-level control (Lyocheck
Levels 1, 2 and 3) run in duplicate at the beginning of
each run and singly at the end of each run. All results for
the controls were within the specified range.

Anaemia in pregnancy is defined as Hb < 110 g/L.
Iron deficiency is defined as serum ferritin (SF) < 20 µg/L (COOK & SKENNE, 1989) and iron-deficiency
anaemia as the same value in an anaemic subject.

Statistical methods

Data were analysed using SPSS version 6.1.3. SF values
were skewed and transformed using natural logarithms. Soil-transmitted nematode egg counts were
transformed using natural logarithms, log,(epg + 1),
where epg is the egg count per gram faeces.

The cure rate (CR) and egg reduction rate (ERR),
induced by albendazole and the albendazole control,
were estimated for soil-transmitted nematode infections.
The CR is defined as the proportion of individuals
excreting eggs at baseline compared to zero eggs
at the post-treatment stool assessment (ALBONICO et al.,
1994). The ERR is the percentage reduction in baseline
gonometric egg counts at a subsequent assessment, and
was estimated as 100(1 − e−D), where D is the mean
difference in transformed egg counts between the baseline
and subsequent assessments (ALBONICO et al.,
1994).

The efficacy of albendazole and iron–folate supple-
ments was evaluated in terms of the change in the prevalence of anaemia, prevalence of iron deficiency,
prevalence of iron-deficiency anaemia. Hb concentration
(AHb) and log-transformed SF concentration
(ASF) between baseline (first-trimester assessment)
and the third-trimester assessment. The AHb was calcu-
lated as Hb concentration at the third-trimester assess-
ment minus Hb concentration at baseline. The ΔSF was
calculated as the natural logarithm of SF concentration at the third trimester minus the natural logarithm of SF
concentration at baseline.

McNemar's test was used to test for significant
changes in the prevalence of anaemia, iron de-
ciency and iron-deficiency anaemia between baseline
and the third-trimester assessment for each intervention
group. Paired t-tests were used to test for significant
changes in Hb concentration and SF concentration for
each intervention group.

ANOVA models were constructed for AHb and ΔSF.
The effect of intervention (albendazole and iron–folate
supplements) on AHb and ΔSF was examined after
adjustment for potentially confounding maternal and
background covariates. The maternal and background
variables examined included social, demographic and
reproductive characteristics, the season at baseline, base-
line prevalence and intensity of soil-transmitted nema-
tode infections, baseline anthropometry, baseline repro-
anthropometry between baseline and the third-trimester
assessment, gestational age at baseline and the third-
trimester assessment. baseline Hb concentration and
baseline SF concentration. Covariates were entered
simultaneously within the intervention effects into the
ANOVA models, Only covariates that remained signifi-
cant in the ANOVA models were retained. The 2-way
interactions between the intervention effects and covari-
ates were examined, but none was found to be signifi-
cant.

The required sample size was determined by specify-
ing the significance level (5%), the power (80%), the
strength of association (0) and the drop-out rate (20%).
The strength of association is the proportion of the
population variation in the dependent variable that is
accounted for by the intervention group. Guideline
values are arbitrarily set at $\bar{w} = 0.059$ and $\bar{w} = 0.138$ for medium and large associations, respectively (COHEN, 1988). According to the sample-size tables developed by FOSTER (1993), the required sample size was 80 for a large association and 195 for a medium association. The target sample size was set at 195.

Ethical considerations

Ethical approval for the study was obtained from research and ethics committees in both Sierra Leone (Research and Ethics Committee, Ministry of Health) and the UK (University of Glasgow). Informed consent was obtained from each subject. Any subject with Hb < 80 g/L at any stage of the study was treated immediately with appropriate therapy and withdrawn from the study in accordance with WHO ethical guidelines (WHO, 1981).

Results

The study population at baseline, in the first trimester of pregnancy, comprised 184 pregnant women. Six women were withdrawn at baseline owing to low Hb concentration (Hb < 80 g/L). A further 53 women were lost to follow-up during pregnancy, including 8 subjects who were withdrawn from the study owing to low Hb concentration. The proportions of dropouts were statistically similar in each intervention group. The results presented here include only the longitudinal cohort of 125 women who remained in the study until the third-trimester assessment. The intervention groups were statistically similar at baseline with respect to demographic, social and reproductive characteristics, prevalence and intensity of soil-transmitted nematode infections, prevalence of iron deficiency, anaemia and iron-deficiency anaemia, Hb concentration and SF concentration.

The age of the 125 subjects at baseline ranged from 15 to 38 years, mean 25.1 (SD 5.5) years; 18.4% were aged < 20 years. Parity ranged from 0 to 10 (median 2). Primigravidae accounted for 15.2% of subjects and grandmultiparae (gravity ≥ 6) for 27.2%. Most women were of the Temne (60.0%), Susu (18.4%) or Mende (9.6%) ethnic group, were married (92.0%), had received no formal education (63.2%), and were petty traders (62.4%) or farmers (13.6%).

At baseline, maternal infections with hookworm, T. trichiura and A. lumbricoides were identified. Hookworm larvae were isolated from 16 (32%) of 50 unfixed stool samples, and examination of the larvae with a light microscope indicated the species to be N. americanus. The prevalence and mean intensity of soil-transmitted nematode infections were as follows: N. americanus 65.6%, 421 (SD 665) epg; T. trichiura 74.4%, 183 (SD 250) epg; and A. lumbricoides 20.0%, 864 (SD 1764) epg. Most women harboured light infections: the proportion of women with egg counts exceeding 1000 epg for N. americanus, T. trichiura, and A. lumbricoides was 7.2%, 2.4% and 3.2%, respectively. Mean Hb concentration was 108.5 (SD 11.9) g/L and the geometric mean SF concentration was 24.1 (SD 16.3, t50.5) pg/L. Anaemia was diagnosed in 56.0% women, iron deficiency in 35.2% women and iron-deficiency anaemia in 18.4% women.

The CRs induced by albendazole for N. americanus, T. trichiura and A. lumbricoides were 90.0% (n = 40), 51.1% (n = 43) and 91.7% (n = 12), respectively, at the post-treatment assessment. The prevalence of soil-transmitted nematode infections at each assessment during pregnancy is shown in Figure 1. Among those treated with albendazole, the geometric mean egg count of N. americanus and A. lumbricoides remained below 1% of the baseline values at the third-trimester assessment. A greater change in geometric mean egg count was observed for T. trichiura, and by the third-trimester assessment the geometric mean egg count was 12.4% of the baseline value.

The ERRs induced by albendazole for N. americanus, T. trichiura and A. lumbricoides were 99.3% (n = 40), 95.0% (n = 45) and 99.6% (n = 12), respectively, at the post-treatment assessment. The percentage reduction in baseline geometric mean egg counts at each subsequent assessment for these infections is shown in Figure 2. Among those treated with albendazole, the geometric mean egg counts of N. americanus and A. lumbricoides remained below 1% of the baseline values at the third-trimester assessment. A greater change in geometric mean egg count was observed for T. trichiura, and by the third-trimester assessment the geometric mean egg count was 12.4% of the baseline value.

The proportion of subjects with anaemia, iron deficiency and iron-deficiency anaemia at baseline (first trimester) and at follow-up in the second and third trimesters is shown in Figure 3. A greater proportion of women were anaemic and had iron deficiency at baseline compared with the follow-up assessments. A similar pattern was observed for iron-deficiency anaemia.
trimesters is given in Figure 3 for each intervention group. Measures of Hb and SF concentration at baseline (first trimester) and at follow-up in the third trimester are presented in Table 1.

In all intervention groups except FeA, there was an increase in the prevalence of anaemia (FeA P = 0.61; FeCA P = 0.039; &A P < 0.001; &CA P = 0.0020) and iron-deficiency anaemia (FeA P = 1.00; FeCA P < 0.001; &A P < 0.001; &CA P < 0.001) between baseline and the third trimester. The prevalence of iron deficiency increased in intervention groups &A and &CA but not in FeA or FeCA (FeA P = 1.00; FeCA P = 0.27; Fe& A P < 0.001; &CA P < 0.001).

In all intervention groups except FeA, there was a significant decrease in mean Hb concentration between baseline and the third trimester (P < 0.001). An ANOVA model (Table 2), which included albendazole (P = 0.0034), iron-folate supplements (P < 0.001), the intervention interaction effect (P = 0.28) and the covariates baseline Hb concentration (P < 0.001) and the season at baseline (early dry season P = 0.055; late dry season P = 0.020), explained 48.4% (adjusted R²) of the variation in ΔHb. Adding further maternal or background variables did not improve the fit significantly. The intervention interaction effect was not significant, and therefore the effects of albendazole and iron–folate supplements were additive. The reduction in baseline Hb concentration in subjects who received albendazole was 6.6 g/L less than in those who received the albendazole control, while the mean reduction in baseline Hb concentration in subjects who received iron–folate supplements was 13.7 g/L less than in those who received the iron–folate control. The reduction in baseline Hb
Table 1. Haemoglobin and serum ferritin concentrations of pregnant women in Sierra Leone at baseline (first trimester) and at follow-up in the third trimester following intervention with albendazole and/or iron–folate supplements

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Number of women</th>
<th>Baseline mean (SD)</th>
<th>Third trimester mean (SD)</th>
<th>Mean difference between baseline and third trimester (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin (g/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeA</td>
<td>32</td>
<td>108.5 (11.8)</td>
<td>107.3 (14.3)</td>
<td>-1.1 (-7.2, 5.0)</td>
</tr>
<tr>
<td>FeCA</td>
<td>35</td>
<td>108.0 (10.9)</td>
<td>97.5 (12.5)</td>
<td>-10.5 (-14.7, -6.4)</td>
</tr>
<tr>
<td>CFeA</td>
<td>29</td>
<td>108.6 (12.9)</td>
<td>88.9 (12.3)</td>
<td>-19.6 (-25.8, -13.5)</td>
</tr>
<tr>
<td>CFeCA</td>
<td>29</td>
<td>109.0 (12.5)</td>
<td>87.2 (11.5)</td>
<td>-21.8 (-27.2, -16.4)</td>
</tr>
<tr>
<td>Serum ferritin (µg/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeA</td>
<td>35</td>
<td>20.0 (- 13.8, +44.6)</td>
<td>20.9 (-11.9, +27.7)</td>
<td>104.8 (65.6, 167.6)</td>
</tr>
<tr>
<td>FeCA</td>
<td>35</td>
<td>27.3 (-18.5, +57.3)</td>
<td>20.4 (-12.0, +28.9)</td>
<td>74.8 (32.0, 107.4)</td>
</tr>
<tr>
<td>CFeA</td>
<td>29</td>
<td>22.4 (-14.6, +42.1)</td>
<td>7.6 (-4.7, +12.3)</td>
<td>34.0 (22.3, 51.7)</td>
</tr>
<tr>
<td>CFeCA</td>
<td>29</td>
<td>27.7 (-10.1, +61.2)</td>
<td>8.9 (-5.7, +15.7)</td>
<td>32.0 (20.8, 49.2)</td>
</tr>
</tbody>
</table>

Fe, iron–folate; CFeA, iron–folate control; A, albendazole; CA, albendazole control; CI, confidence interval. Serum ferritin data were log-transformed for analysis. Geometric means (±SD) are given. Mean difference (D) is presented as 100(e^D), and corresponds to the third-trimester values as a percentage of the baseline values.

Table 2. Effect of albendazole and iron–folate supplements on the change in haemoglobin (ΔHb) concentration between baseline (first trimester) and the third trimester in 125 pregnant women in Sierra Leone

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ANOVA model estimates B(SE)</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>6.55 (2.19)</td>
<td>8.97</td>
<td>0.0034</td>
</tr>
<tr>
<td>Iron–folate supplements</td>
<td>13.67 (2.22)</td>
<td>38.05</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Intervention interaction</td>
<td>2.46 (2.28)</td>
<td>1.19</td>
<td>0.28</td>
</tr>
<tr>
<td>Baseline Hb concentration (g/L)</td>
<td>-0.72 (0.09)</td>
<td>61.05</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Season at baseline</td>
<td>0.030 (0.155)</td>
<td>0.005</td>
<td>0.76</td>
</tr>
<tr>
<td>D1</td>
<td>6.13 (3.16)</td>
<td>3.75</td>
<td>0.055</td>
</tr>
<tr>
<td>D2</td>
<td>7.64 (3.25)</td>
<td>5.54</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Dummy variables: early dry season (November–January) D1 = 1, D2 = 0; late dry season (February–April) D1 = 0, D2 = 1; early wet season (May–July) D1 = 0, D2 = 1.

Table 3. Effect of albendazole and iron–folate supplements on the change in log-transformed serum ferritin concentration (ΔSF) between baseline (first trimester) and the third trimester in 125 pregnant women in Sierra Leone

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ANOVA model estimates B(SE)</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>0.047 (0.151)</td>
<td>0.10</td>
<td>0.76</td>
</tr>
<tr>
<td>Iron–folate supplements</td>
<td>0.045 (0.152)</td>
<td>38.66</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Intervention interaction</td>
<td>0.039 (0.153)</td>
<td>0.04</td>
<td>0.85</td>
</tr>
<tr>
<td>Baseline SF concentration (µg/L)</td>
<td>-0.760 (0.073)</td>
<td>108.75</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Season at baseline</td>
<td>-0.519 (0.181)</td>
<td>8.18</td>
<td>0.005</td>
</tr>
<tr>
<td>D1</td>
<td>-0.558 (0.224)</td>
<td>6.23</td>
<td>0.014</td>
</tr>
<tr>
<td>D2</td>
<td>-0.558 (0.224)</td>
<td>6.23</td>
<td>0.014</td>
</tr>
</tbody>
</table>

Serum ferritin data were log-transformed for analysis.

Dummy variables: early dry season (November–January) D1 = 1, D2 = 0; late dry season (February–April) D1 = 0, D2 = 1; early wet season (May–July) D1 = 0, D2 = 1.
first-trimester assessment was taken in the late dry season as compared to the early dry season and early wet season. Baseline SF concentration was negatively associated with ASF.

No adverse pregnancy outcomes were linked with albendazole. Two subjects miscarried within 14 days of intervention, one in group FEA and the other in group C0C0. A further 6 women miscarried subsequently: 3 of these women received albendazole and the other 3 the albendazole control. One mother who received albendazole gave birth to an infant with bilateral supernumerary fingers, a relatively common congenital abnormality in West Africa.

Discussion

Our results indicate that mild soil-transmitted nematode infections contribute to reduced Hb levels in pregnant women in Sierra Leone, where there is a profound iron deficiency and anaemia. Removal of soil-transmitted nematode infections with a single dose of albendazole at the beginning of the second trimester, combined with daily iron–folate supplements, stabilized the prevalence of anaemia and iron-deficiency anaemia and minimized the decline in Hb concentration during pregnancy. Combination of albendazole with iron-folate supplements (ACC/SCN, 1991) probably has additive effects compared to albendazole alone. The corresponding value for iron–folate supplements was 13.7 g/L Hb. The effects of albendazole and iron–folate supplements were additive, and therefore the mean benefit of receiving both albendazole and iron–folate supplements was 20.2 g/L Hb.

Women who received iron–folate supplements also experienced less decline in first-trimester SF concentration. Albendazole did not appear to influence the change in first-trimester SF concentration, which may indicate that iron savings associated with treatment were not sufficient to allow net storage in women who received albendazole. The effects of albendazole may have been confounded by concomitant infections and inflammatory processes, which elevate SF levels independently of iron status (LIPSCHITZ et al., 1974), or by heterogeneous dietary iron intake across the intervention groups. If the primary purpose of interventions to control maternal anaemia is to normalize haemoglobin concentration, the implications of these findings would appear to have over single-dose albendazole. However, other factors should also be considered. First, iron–folate supplements may induce a greater haematological response, but this response may be short-lived if the underlying causes of anaemia, including intestinal blood loss, are not addressed. Secondly, the haematological response observed in the present study occurred over 24 weeks of daily supplementation under semi-supervised conditions, and is likely to represent the maximum achievable impact. Once the semi-supervised conditions are removed, the effectiveness of supplements is likely to be reduced. In many countries, the impact of national anaemia-control programmes on maternal anaemia has been disappointing, largely owing to low access to and low adherence with supplements (ACC/SCN, 1991; GALLOWAY & MCGUIRE, 1994).

The clear advantage that albendazole has over iron–folate supplements is the ease of administration. In this population, a single dose administered at the first antenatal clinic in the second trimester of pregnancy induced an improvement in Hb concentration that, while less than that produced by the daily iron–folate supplements, was not dependent on further treatment during pregnancy. In this respect, control of soil-transmitted nematodes may be more effective than iron–folate supplementation, albeit less efficacious under controlled conditions. Albendazole also has other benefits. This anthelmintic is broad spectrum and can rid the body of multiple parasites. It may improve food intake by relieving the symptoms of soil-transmitted nematode infection that reduce appetite and by eliminating the physiological causes of anorexia induced by infection. In addition, it may reduce the risk of complications associated with ectopic migration of nematode larvae or worms (MACLEOD, 1988). Furthermore, integration of albendazole therapy into strategies for the control of maternal anaemia may encourage greater clinic attendance and participation in iron–folate supplementation programmes. Generic albendazole from UNICEF costs only US$0.035 per 400-mg dose.

Despite the diverse benefits of albendazole, it is clear that the poor haematological status of women in this community cannot be corrected with albendazole alone. Iron–folate supplementation is therefore an essential component of anaemia prevention and control in these pregnant women.

Further studies are needed to clarify the contribution of other aeriological factors to maternal anaemia in Sierra Leone, particularly malaria, sickle-cell disease and AIDS. Malaria transmission occurs throughout the year, but peaks at the beginning and end of the wet season. The prevalence of placental malaria infection has been shown to peak in the early wet season in Sierra Leone (BLACK-LOVEY & GORDON, 1983). Although soil-transmitted nematode infections were not included in the present study, it was revealed that pregnant women whose baseline assessment was in the early or late dry season (May–July) experienced greater decline in Hb concentration during pregnancy that those whose baseline assessment was in the early or late dry season.

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References


ALBENDAZOLE THERAPY DURING PREGNANCY

writes in his preface, this book represents a 'medical revolution (and acceptance) of the 'germ theory' of disease, that the clinical disease was well recognized long before the aetiology? At first (like most other [non-contagious] diseases) it was attributed to miasmas. Following elucidation (and acceptance) of the 'germ theory' of disease, repeated searches (most of them using experimental

animals—usually chickens) failed to incriminate an infectious agent in the causation of the affliction. Then came a search for a dietary component and the great breakthrough came in 1907 with 2 controlled clinical trials carried out in Malayan or Javanese prisoners which established that, whilst those on a staple diet of white rice suffered from the disease, individuals fed parboiled (brown) rice did not. After some 20 years (in the early 1930s) highly active crystals of thiamin were obtained, and almost 10 years later this compound was for the first time synthesized. This led to chemical analysis of food-stuffs, and determination of precise thiamin requirements of different individuals. A great deal of chemistry follows, but let that not put the reader off: the 'detective story' can be well understood without an in-depth knowledge of this discipline. The research has been truly multidisciplinary.

Carpenter shows how the disease was to re-emerge in the South-East Asian prison-camps of World War II (1939–45). Of relevance to the present day, much of the mental deterioration in chronic alcoholics (of whom there are many in the developing, as well as the 'developed' world) is a result of thiamin-deficiency. Should this vitamin, therefore, be added to beer and wine—as part of a public health campaign? The book contains 12 chapters, followed by 2 appendices devoted to the chemistry and biochemistry, respectively, of thiamin. The 'notes' to this highly erudite, but eminently readable, text run to 20 and the references take up a further 34 pages. The 7¼-page index is adequate.